J. Helminthol. Soc. Wash.
61(1), 1994, pp. 95–102

Helminth Parasites Collected from *Rattus rattus* on Lanyu, Taiwan

HIDEO HASEGAWA, JUN KOBAYASHI, AND MASAMITSU OTSURU
Department of Parasitology and Research Center of Comprehensive Medicine, Faculty of Medicine, University of the Ryukyus, Nishihara, Okinawa 903-01, Japan

ABSTRACT: The helminth fauna of 53 *Rattus rattus* captured on Lanyu, Taiwan, was studied and compared with that found in a survey carried out on this island in 1959. One trematode, 3 cestode, and 14 nematode species were detected. Among the nematodes, *Calodium hepaticum* (=*Capillaria hepatica*), *Strongyloides ratti, Strongyloides venezuelensis, Orientostrongylus tenorai, Mastophorus muris, Ascarops strongylina,* and *Pterygodermatites whartoni* were recorded for the first time from the rat on this island. *Gongylonema neoplasticum* and *Protospirura muricola,* which had been recorded by the survey in 1959, were not observed. Morphological and morphometric data are given for *O. tenorai, Globocephalus connorfilli, A. strongylina, Pterygodermatites tani,* and *P. whartoni. Orientostrongylus ratti* was synonymized with *O. tenorai. Globocephalus connorfilii* and *A. strongylina* were assumed to be shared between rat and swine on this island.

KEY WORDS: Nematoda, Cestoda, Trematoda, survey, *Rattus rattus,* Lanyu, Taiwan.

Lanyu (Orchid Island, Koto-sho or Botel Tobago; 22°00′–05′N, 121°29′–36′E; ca. 45 km²) is a small island located about 70 km southeast of the main island of Taiwan. This island is famous ethnologically for its aboriginal Yami tribe but has been also noticed zoogeographically because its fauna is composed of both the Philippine and Taiwan elements (cf. Kano, 1935–1936). On Lanyu, *Rattus rattus* is abundant in the fields. During a survey on tsutsugamushi disease (scrub typhus) on this island in 1990, 53 rats were trapped. This article reports the helminths collected from the rats in comparison with the results of a similar survey carried out on Lanyu in 1959 (Myers and Kuntz, 1960). Brief descriptions are made for 5 nematode species that have not been described adequately from murines and/or have special taxonomical interest.

Materials and Methods

Rats, *Rattus rattus,* were captured with wire-cage live traps in the bushes along the southwestern coast of Lanyu during the period 5–10 August 1990. They were anesthetized to death with ether. Then, laparotomy was performed, and the liver was checked with naked eyes for the presence of *Calodium hepaticum* (=*Capillaria hepatica*) eggs and *Taenia taeniaeformis* strobilocerci. The alimentary canal and lungs were resected and fixed in 5% formalin solution. Helminths were collected from these viscera under a dissecting microscope. Trematodes and cestodes were stained with Meyer's hematoxylin or cleared in glycerin-alcohol solution. Nematodes were cleared in glycerin-alcohol or creosote for microscopical observation. Figures were made with the aid of a drawing tube equipped on a Nikon Optiphoto microscope. Measurements are in micrometers unless otherwise stated. Representative specimens are deposited in the National Science Museum, Tokyo (NSMT).

Results

The helminths detected are shown in Table 1 and are compared with the data of Myers and Kuntz (1960). One trematode, 3 cestode, and 14 nematode species were collected. *Echinostoma* sp. was strongly shrunken, preventing species identification. *Gongylonema neoplasticum* and *Protospirura muricola,* which had been recorded by Myers and Kuntz (1960), were not observed, whereas 6 nematode species were first recorded in the present study (i.e., *C. hepaticum, Strongyloides ratti, Strongyloides venezuelensis, Orientostrongylus tenorai, Mastophorus muris,* and *Ascarops strongylina*). *Angiostrongylus cantonensis* was not recorded in Myers and Kuntz (1960) but later reported by the same authors (Kuntz and Myers, 1964) from Lanyu. Concurrent infection with *S. ratti* and *S. venezuelensis* was common; however, it was difficult to obtain all worms because they were embedded in the villi of the small intestine. Hence, the exact prevalence of each species could not be determined.

Orientostrongylus tenorai Durette-Desset, 1970

Syn. *Orientostrongylus ratti* Kamiya and Ohbayashi, 1980

(Trichostrongyloidea: Heligmonellidae: Nippostrongylinae)

MALE: Length 1.47–1.78 mm, width at midbody 50–70. Cephalic vesicle 36–42 long by 22–28 wide. Nerve ring 103–133 and excretory pore 154–179 from anterior extremity. Esophagus 282–313 long by 20–26 wide near posterior end.

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Table 1. Prevalence of helminth parasites in *Rattus rattus* on Lanyu, Taiwan (%).

	Year of examination:	1959*	1990
	No. of rats examined:	80	53
	Site in host		
Trematoda			
Echinostoma sp.	Small intestine	—	1.9
Cestoidea			
Taenia taeniaeformis	Liver	—	5.7
Raillietina celebensis	Small intestine	—	35.8
Hymenolepis diminuta	Small intestine	—	3.8
Nematoda			
Calodium hepaticum	Liver	0.0	18.9
Eucoleus bacillatus	Stomach	0.0	9.4
Capillaria sp.	—	2.5	0.0
Strongyloides spp.†	Small intestine	0.0	71.7
Angiostrongylus cantonensis	Pulmonary artery	0.0	1.9
Nippostrongylus brasiliensis	Small intestine	38.8	69.8
Orientostrongylus tenorai	Small intestine	0.0	66.0
Globocephalus connorfilii	Small intestine	6.3‡	11.3
Syphacia muris	Cecum	1.3‡	20.8
Heterakis spumosa	Large intestine	1.3	22.6
Gongylonema neoplasticum	Stomach	20.0	0.0
Protospirura muricola	Stomach	6.3	0.0
Mastophorus muris	Stomach	0.0	22.6
Ascarops strongylina	Stomach	0.0	5.7
Pterygodermatites spp.§	Small intestine	11.3	13.2

* Data from Myers and Kuntz (1960).
† Mixture of *S. ratti* and *S. venezuelensis.*
‡ Species identification was not made.
§ Mixture of *P. tani* and *P. whartoni.*

Cuticular ridges number 19 or 20 at midbody. Spicules 82–94 long.

FEMALE: Length 1.70–2.33 mm, width at midbody 52–70. Cephalic vesicle 38–44 long by 24–32 wide. Nerve ring 105–125 and excretory pore 128–179 from anterior extremity. Esophagus 269–344 long by 26–32 wide near posterior end. Cuticular ridges number 20 at midbody. Vulva 102–132 and anus 42–60 from posterior extremity. Vagina vera 29–40 long, vestibule 30–42 long, sphincter 28–46 long, and infundibulum 80–104 long. Eggs 64–80 by 24–36.

HOST: *Rattus rattus.*

SITE IN HOST: Small intestine.

LOCALITY: Lanyu, Taiwan.

SPECIMENS DEPOSITED: NSMT As-2261.

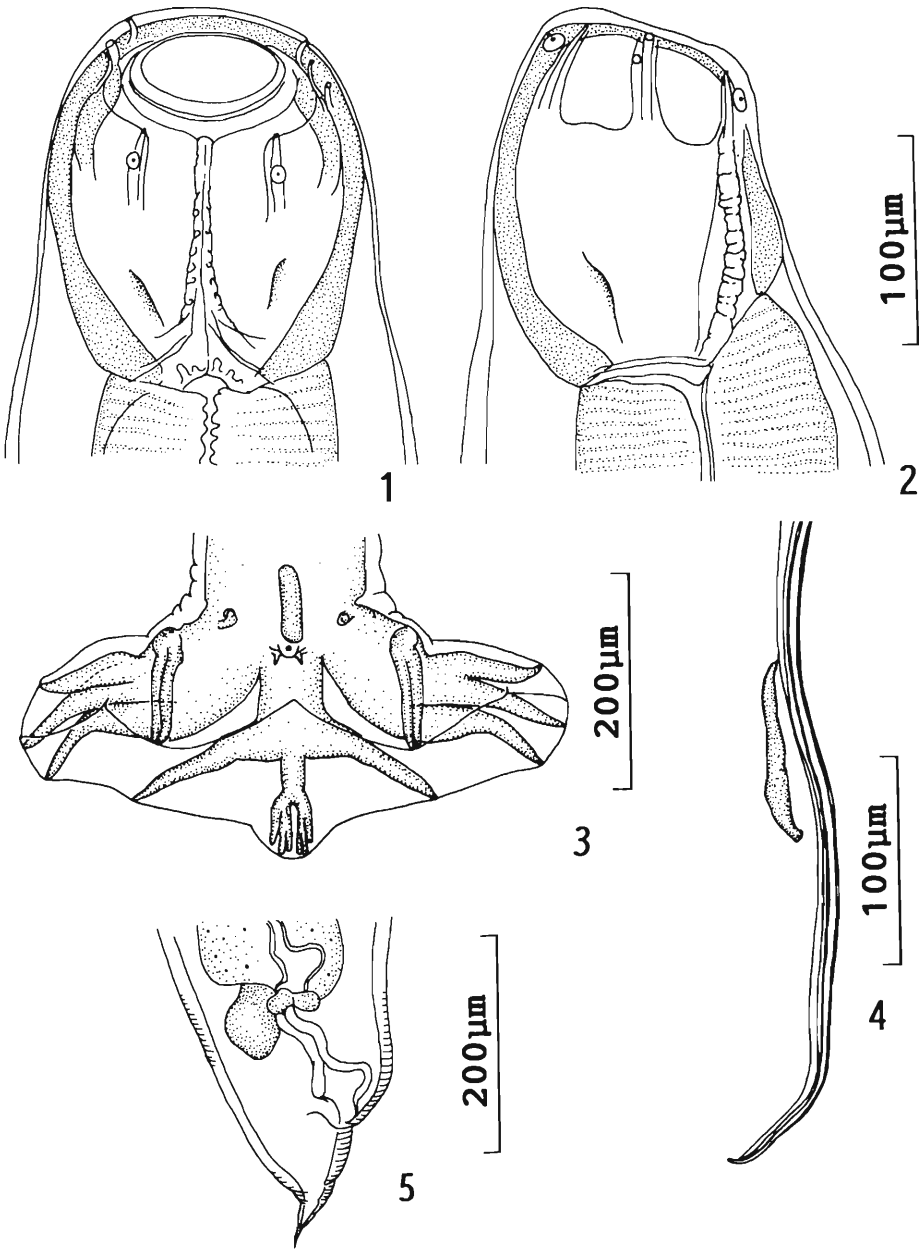
REMARKS: The number of cuticular ridges of the present material is identical to that described for *Orientostrongylus ratti* Kamiya and Ohbayashi, 1980, which was collected from *R. rattus* and *R. norvegicus* in Thailand (M. Kamiya and Ohbayashi, 1980). However, *O. ratti* is distinguished from *O. tenorai* only by the slight difference in number of cuticular ridges (M. Kamiya and Ohbayashi, 1980). Fukumoto and Ohbayashi (1985) reported a considerable variation in the number of the cuticular ridges of *Orientostrongylus ezoensis* Tada, 1975, from *R. norvegicus* in Japan. It is highly probable that the difference in the number of the cuticular ridges between *O. tenorai* and *O. ratti* is an intraspecific variation. *Orientostrongylus ratti* is thus regarded as a junior synonym of *O. tenorai.*

Globocephalus connorfilii Lane, 1922
(Ancylostomatoidea: Ancylostomatidae: Ancylostomatinae)
(Figs. 1–5)

GENERAL: Small but stout worm. Buccal cavity well developed, globular, with thick wall (Figs. 1, 2). Oral opening inclined dorsally (Fig. 2). Esophageal gutter extending to level slightly posterior to oral opening (Figs. 1, 2). Subventral lancets of buccal cavity weakly developed (Figs. 1, 2).

MALE (4 worms): Length 4.15–4.60 mm, width at midbody 246–265. Buccal cavity 140–

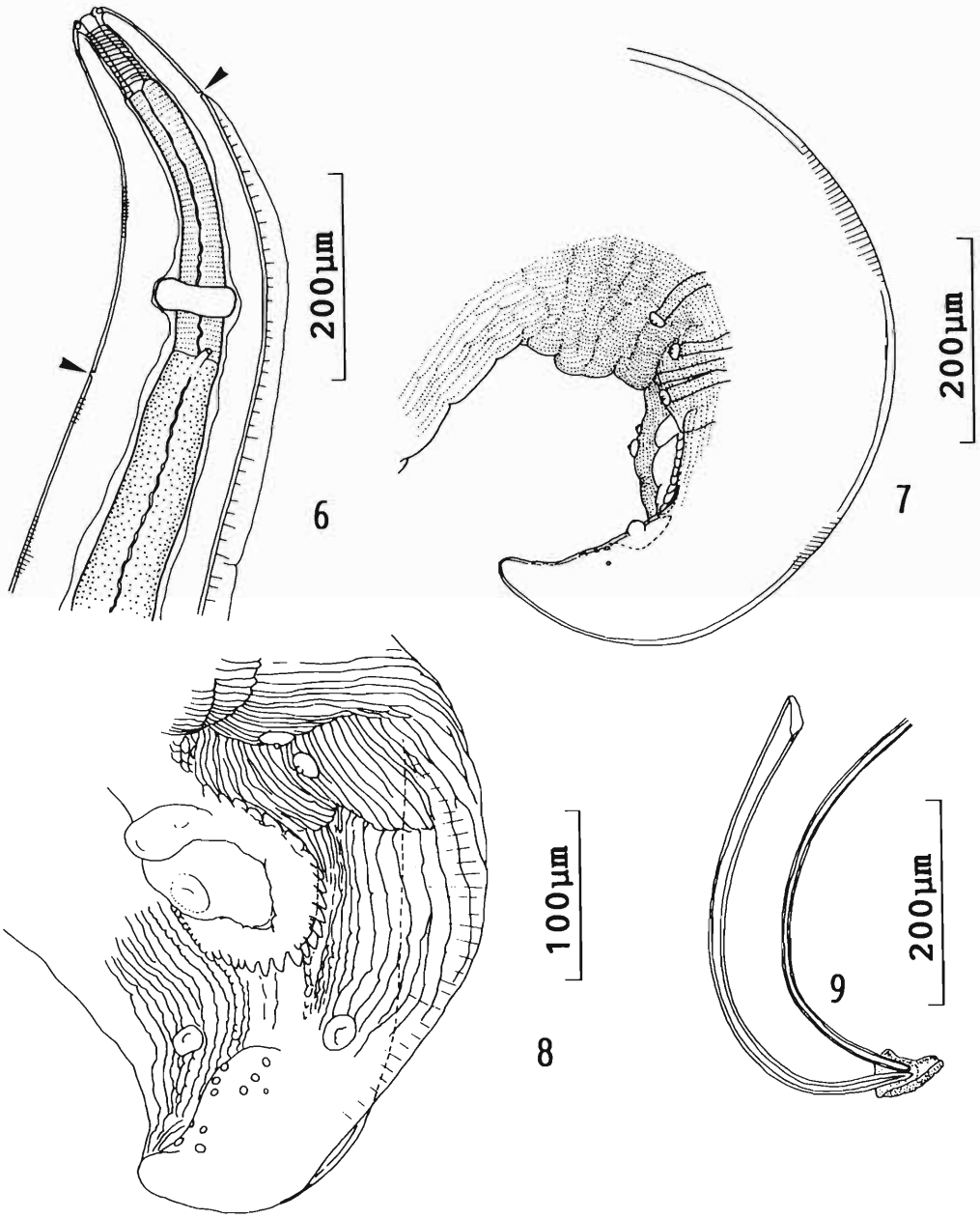
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Figures 1–5. ***Globocephalus connorfilii*** **collected from** ***Rattus rattus*** **on Lanyu, Taiwan. 1, 2. Cephalic extremity, dorsal (1) and left lateral (2) views. 3. Bursa copulatrix, ventral view. 4. Spicules and gubernaculum, right lateral view. 5. Tail of female, right lateral view.**

160 long by 101–113 wide. Nerve ring 382–454, excretory pore 324–390, and deirids 332–474 from anterior extremity. Esophagus 632–679 long by 133–150 wide. Bursa copulatrix well developed, symmetrical: prebursal rays minute; ventral rays thin, equal, fused along total length; lateral rays stout, divergent from each other, and externolateral ray shorter than other laterals and ending distant from bursal rim; externodorsal rays arising from middle of dorsal ray, directing posterolaterally; dorsal ray divided at distal ⅓ into 2 branches, each of which trifid distally (Fig.

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Figures 6–9. ***Ascarops strongylina*** **collected from** ***Rattus rattus*** **on Lanyu, Taiwan. 6. Anterior part of male, ventral view. Arrowheads indicate deirids. 7. Posterior part of male, left lateral view. 8. Caudal extremity of male, left subventral view. 9. Spicules and gubernaculum, right lateral view.**

3). Genital cone with 1 pair of minute pedunculate papillae on posterior lip and 1 unpaired sessile papilla on anterior lip (Fig. 3). Spicules equal, filiform, distal ends fused, 450–488 long (Fig. 4). Gubernaculum boat shaped, about 80 long (Figs. 3, 4).

FEMALE (7 worms): Length 4.53–7.15 mm, width at midbody 245–435. Buccal cavity 160–183 long by 117–140 wide. Nerve ring 356–514, excretory pore 348–411, and deirids 363–425 from anterior extremity. Vulva 2.88–4.48 mm from anterior extremity, dividing body unequal-

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ly, with forebody : hindbody ratio of 1.51–1.84: 1. Esophagus 600–814 long by 152–198 wide. Tail conical, distally pointed sharply, 129–176 long (Fig. 5). Eggs present in females larger than 6.5 mm in length, elliptical, thin-shelled, containing 1–2-cell-stage embryos, 54–64 by 28–36.

HOST: *Rattus rattus.*

SITE IN HOST: Small intestine.

LOCALITY: Lanyu, Taiwan.

SPECIMENS DEPOSITED: NSMT As-2262.

REMARKS: Most of the morphological characteristics of the present worms are identical to the original description of *G. connorfilii* by Lane (1922, 1923). Although it has been stated that the esophageal gutter is protruded only slightly into the buccal capsule (cf. Popova, 1955), the figure in the original description (Lane, 1923) indicates that the gutter is fairly extended as in the present material. *Globocephalus connorfilii* is a common parasite of swine of the Oriental Region and Pacific islands and has been also recorded from *Leopoldamys sabanus* (=*Rattus sabanus*) in Malaysia (Singh and Cheong, 1971).

Ascarops strongylina (Rudolphi, 1819)
(Spiruroidea: Spirocercidae: Ascaropsinae) (Figs. 6–9)

GENERAL: Slender worm. Lips poorly developed. Buccal cavity with 6 teeth. Pharynx straight, with 15–19 spiral thickenings (Fig. 6). Deirids asymmetrical (Fig. 6). Left lateral ala well developed, arising from left deirid (Fig. 6). Right lateral ala absent.

MALE (1 worm): Posterior body coiled ventrally (Fig. 7). Length 13.5 mm, width at midbody 253. Pharynx 86 long by 32 wide. Muscular esophagus 336 long by 46 wide; glandular esophagus 2.83 mm long by 110 wide. Nerve ring 316, excretory pore 363, right deirid 386, and left deirid 120 from anterior extremity. Caudal alae thick and asymmetrical: right ala larger. Perianal surface with rugose longitudinal ridges (Figs. 7, 8). Anus surrounded by large hemicircular disc with prominently serrated margin (Fig. 8). Four pairs of pedunculate papillae situated preanally, 1 pair of pedunculate papillae at midtail, and 4 pairs of minute sessile papillae and phasmidial pores grouped on ventromedian elevation near posterior extremity (Fig. 8). Spicules markedly dissimilar: right one 520 long and left one filiform, 2.10 mm long (Fig. 9). Gubernaculum triangular in ventral view, 64 long (Fig. 9). Tail 312 long.

FEMALE (2 worms): Length 17.8–21.3 mm, width at midbody 277–300. Pharynx 90–102 long by 32–34 wide. Muscular esophagus 312–376 long by 44–50 wide; glandular esophagus 2.85–3.59 mm long by 119–132 wide. Nerve ring 293–320, excretory pore 343–395, right deirid 339–394, left deirid 152–261, and vulva 8.3–10.9 mm from anterior extremity. Tail 250–254 long. Only unfertilized eggs present.

HOST: *Rattus rattus.*

SITE IN HOST: Small intestine.

LOCALITY: Lanyu, Taiwan.

SPECIMENS DEPOSITED: NSMT As-2263.

REMARKS: Although the present male has a somewhat shorter left spicule, other characteristics are identical to those of *Ascarops strongylina* (cf. Shmitova, 1964; Shoho and Machida, 1979). *Ascarops strongylina* is a well-known, cosmopolitan nematode of swine, but it has not been recorded from *Rattus.*

Pterygodermatites tani (Hoeppli, 1928)
(Rictularioidea: Rictulariidae)

MALE (2 worms): Length 1.66–6.80 mm, width at midbody 126–514. Number of comb pairs 64–68; last several pairs small and pointed. Buccal depth 28–54. Muscular esophagus 162–442 long by 28–78 wide; glandular esophagus 0.51–1.75 mm long by 48–137 wide. Nerve ring 132–328, excretory pore 188–458, and deirids 246–593 from anterior extremity. Posterior end not bent ventrally. Preanal fans 2 or 3 in number, anterior 1 or 2 rudimentary, posterior 1 moderately developed. Tail conical, 76–171 long. Caudal papillae 10 pairs: 2 pairs preanal, 1 pair adanal, and 7 pairs postanal. Spicules almost equal, simple, slightly bent ventrally: right spicule 76–81 long and left spicule 70–84 long.

HOST: *Rattus rattus.*

SITE IN HOST: Small intestine.

LOCALITY: Lanyu, Taiwan.

SPECIMENS DEPOSITED: NSMT As-2264.

REMARKS: Morphology of the present males is identical to the previous descriptions of the male *P. tani* (cf. Le-Van-Hoa, 1965; Hasegawa et al., 1993)

Pterygodermatites whartoni Tubangui, 1931
(Rictularioidea: Rictulariidae)

GENERAL: Morphology identical to that of *P. tani* except male caudal structure.

MALE (3 worms): Length 4.58–6.15 mm, width at midbody 254–359. Number of comb

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pairs 60–62. Buccal depth 46–51. Muscular esophagus 265–394 long by 54–76 wide; glandular portion of esophagus 1.13–1.61 mm long by 98–128 wide. Nerve ring 238–312, excretory pore 308–421, and deirids 419–600 from anterior extremity. Posterior end bent ventrally. Preanal fans 3–4 in number, posterior 3 well developed. Tail conical, 160–228 long. Caudal papillae 10 pairs: 2 preanal, 1 adanal, and 7 postanal. Spicules dissimilar, simple, curved ventrally: right spicule 65–83 long and left spicule 138–170 long.

HOST: *Rattus rattus.*

SITE IN HOST: Small intestine.

LOCALITY: Lanyu, Taiwan.

SPECIMENS DEPOSITED: NSMT As-2265.

REMARKS: The present males are identical morphologically to the previous descriptions of *P. whartoni* (cf. Schmidt and Kuntz, 1967; Hasegawa et al., 1993). Females of *P. whartoni* are indistinguishable from those of *P. tani* (cf. Hasegawa et al., 1993).

Discussion

All of the present nematode species from Lanyu except *G. connorfilii* and *A. strongylina* had been apparently introduced to this island from the adjacent areas by the rats because these parasites have also been recorded from *R. rattus* and *R. norvegicus* of the Philippines, the main island of Taiwan, South China, and the Ryukyu Archipelago (cf. Yokogawa, 1920; Tubangui, 1931; Chen, 1936; M. Kamiya et al., 1968; H. Kamiya and Machida, 1977; M. Kamiya and Kanda, 1977; Hasegawa et al., 1988, 1993; Hasegawa, 1990). The rats on Lanyu are considered to have arrived relatively recently because the Yami people have an oral tradition that there was no rat before large ships called at the ports of the island (Kano, 1933). The geographical origin of *R. rattus* on Lanyu has not been adequately studied, although its morphological affinity with the Philippine population was pointed out (cf. Tokuda, 1941).

There are several discrepancies in the species composition and prevalence of the rat parasites on Lanyu between the survey by Myers and Kuntz (1960) and the present one (Table 1). It is probable that the helminth fauna of the rats on this island has changed during the past 3 decades. It is also likely, however, that some of the species were overlooked by Myers and Kuntz (1960) because minute nematodes such as *Strongyloides* spp. and male *S. muris* were not recorded in their report. *Orientostrongylus tenorai* resembles immature *Nippostrongylus brasiliensis* in appearance, and both have been confused in many surveys until recently.

It is of special interest that 2 swine nematodes, *G. connorfilii* and *A. strongylina,* were found from *R. rattus* on Lanyu. They were apparently mature adults, indicating that the rat could be a suitable host of these parasites, although the prevalence and intensity of *A. strongylina* was low and its females had only unfertilized eggs. On Lanyu, the Yami people rear, often pasture, small short-eared black pigs, which have affinities with those of the Philippines (Tanaka et al., 1981). Although no parasitological examination of the pigs was made, it is highly probable that *G. connorfilii* and *A. strongylina* are shared by the pigs and the rodents on this island.

Rodents have been known as paratenic hosts of *A. strongylina* but have not been recorded as natural final hosts of it (cf. Dimitrova, 1966). However, Ono (1933) observed that *A. strongylina* developed to adult stage in rabbits experimentally infected with the third-stage larvae from dung beetles, demonstrating that this nematode has a wider host range. This observation was confirmed by Chowdhury and Pande (1969), who also recovered mature *A. strongylina* from the stomachs of rabbits and guinea pigs by experimental infection. Moreover, Webster and Speckmann (1977) reported many adults of *A. strongylina* from the proventriculus of a cockatoo. It is thus suggested that the presence of adult *A. strongylina* in a wild rodent is not an exceptional phenomenon.

A species of the genus *Globocephalus* has been recorded from the feral rat, *Diplothrix legata,* on Amami and Okinawa islands, the Ryukyu Archipelago, Japan, where wild boar, *Sus scrofa riukiuanus,* is distributed (Itagaki et al., 1981; Hasegawa, 1987). Itagaki et al. (1981) identified it as *G. longemucronatus* (Molin, 1861) based on Popova (1955) and Yamaguti (1935). Hartwich (1986), however, claimed that the criteria used by Popova (1955) were incorrect and considered that *G. longemucronatus* sensu Yamaguti, 1935, was *G. connorfilii.* The species of *Globocephalus* parasitic in *D. legata* is hence considered to be *G. connorfilii,* although the males have somewhat longer spicules (0.60–0.67 mm in males with body length of 3.40–5.40 mm [Itagaki et al., 1981], 0.60–0.77 mm in males with body length of 5.4–6.4 mm [Hasegawa, unpubl. data]).

Two additional species of the genus *Globo-*

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cephalus are known from rodents: *Globocephalus howelli* (Khalil, 1973) from *Cricetomys gambianus* of Tanzania and *Globocephalus callosciuri* Cassone and Krishnasamy, 1986, from *Callosciurus caniceps* of Malaysia (Khalil, 1973; Cassone and Krishnasamy, 1986). *Globocephalus callosciuri* resembles *G. connorfilii* closely in having weakly developed subventral lancets in the buccal cavity but differs in having a longer buccal capsule (240 long in holotype male with body length of 5.89 mm and 310 long in paratype female with body length of 9.65 mm [Cassone and Krishnasamy, 1986]).

Pterygodermatites tani and *P. whartoni* are indistinguishable by female morphology, but their males are quite different in genital morphology (cf. Le-Van-Hoa, 1965; Hasegawa et al., 1993). The concurrent infection of both species in a rat on the small island may indicate that *P. tani* has 2 types of males, 1 of which has been regarded as *P. whartoni* (cf. Hasegawa et al., 1993).

Acknowledgments

Sincere thanks are rendered to Mr. H. M. Lin for his kind collaboration in collecting rats on Lanyu and to Dr. K. Tuchiya of Miyazaki Medical School, Dr. K. Tanaka of Tokyo University of Agriculture, Dr. M. Asakawa of Rakuno Gakuen University, and Dr. Y. Yokohata of Hokkaido University for their kind advice on the taxonomy of the hosts and parasites. This research was supported partly by a Grant-in-Aid for Overseas Scientific Survey No. 63041108 from the Ministry of Education, Science and Culture, Japan.

Literature Cited

Cassone, J., and M. Krishnasamy. 1986. *Globocephalus callosciuri* n. sp. (Nematoda, Ancylostomatidae), parasite d'Écureuil de Malaisie. Bulletin du Muséum National d'Histoire Naturelle, Paris, 4e série, 8, Section A, 3:501–504.

Chen, H. T. 1936. *Rictularia tani* Hoeppli from rats in Canton (Nematoda: Rictulariidae). Lingnan Science Journal 15:283–286.

Chowdhury, N., and B. P. Pande. 1969. Intermediate hosts of *Ascarops strongylina* in India and the development of the parasite in rabbit and guinea-pig. Indian Journal of Animal Sciences 39:139–148.

Dimitrova, E. 1966. Occurrence of *Ascarops strongylina* and *Physaloptera sexalatus* in Bulgaria and their intermediate and reservoir hosts in Strandja Mountain. Bulletin of the Central Helminthological Laboratory 11:43–56. (In Bulgarian.)

Fukumoto, S. I., and M. Ohbayashi. 1985. Variations of synlophe of *Orientostrongylus ezoensis* Tada, 1975 (Nematoda: Heligmonellidae) among different populations in Japan. Japanese Journal of Veterinary Research 33:27–43.

Hartwich, G. 1986. Zur Artidentität der Schweineparasiten *Globocephalus longemucronatus* und *G. urosubulatus* (Nematoda, Strongyloidea). Angewandte Parasitologie 27:207–214.

Hasegawa, H. 1987. Parasites collected from a feral rat, *Diplothrix legata,* on Okinawa Island, Japan. Biological Magazine, Okinawa 25:68. (In Japanese.)

———. 1990. Nematodes of the family Heligmonellidae (Trichostrongyloidea) collected from rodents of the Ryukyu Archipelago and Taiwan. Journal of Parasitology 76:470–480.

———, **S. Arai, and S. Shiraishi.** 1993. Nematodes collected from rodents on Uotsuri Island, Okinawa, Japan. Journal of the Helminthological Society of Washington 60:39–47.

———, **Y. Orido, Y. Sato, and M. Otsuru.** 1988. *Strongyloides venezuelensis* Brumpt, 1974 (Nematoda: Strongyloididae) collected from *Rattus norvegicus* in Naha, Okinawa, Japan. Japanese Journal of Parasitology 37:429–434.

Itagaki, H., A. Uchida, K. Uchida, and T. Itagaki. 1981. Helminth fauna of the Amami Islands, Japan. 1. *Globocephalus longemucronatus* from a wild rat *Diplothrix legata* (Nematoda: Strongylidae). Japanese Journal of Parasitology 30:51–56.

Kamiya, H., and M. Machida. 1977. *Brachylaima ishigakiense* n. sp. (Trematoda, Brachylaimidae) from roof rat, *Rattus rattus* Linnaeus. Bulletin of the National Science Museum, Series A (Zoology) 3:125–129.

Kamiya, M., H. Chinzei, and M. Sasa. 1968. A survey on helminth parasites of rats in southern Amami, Japan. Japanese Journal of Parasitology 17: 436–444. (In Japanese.)

———, **and T. Kanda.** 1977. Helminth parasites of rats from Ishigaki Is., Southwestern Japan, with a note on a species *Pterygodermatites* (Nematoda: Rictulariidae). Japanese Journal of Parasitology 26:271–275.

———, **and M. Ohbayashi.** 1980. Studies on the parasite fauna of Thailand II. Three nematode species of the genus *Orientostrongylus* Durette-Desset, 1970. Japanese Journal of Veterinary Research 28: 7–11.

Kano, T. 1933. Zoogeographical studies on Lanyu. 1. Geographical Review of Japan 9:381–399. (In Japanese.)

———. 1935–1936. Some problems concerning the biogeography of Kotosho, near Formosa. Geographical Review of Japan 11:950–995, 1027–1055; 12:33–46, 154–177, 911–935, 997–1020, 1107–1133. (In Japanese.)

Khalil, L. F. 1973. *Characostomum howelli* n. sp. (Nematoda: Strongylidae) from the giant African rat *Cricetomys gambianus* and other helminths from Tanzania. Journal of Helminthology 47:283–287.

Kuntz, R. E., and B. J. Myers. 1964. The lungworm, *Angiostrongylus cantonensis* of rodents in Taiwan (Formosa) and its offshore islands. American Jour-

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nal of Tropical Medicine and Hygiene 13:686–692.

Lane, C. 1922. A preliminary note on two Strongylata from swine in the Pacific. Annals and Magazine of Natural History, Series 9 9:683–685.

———. 1923. Some Strongylata. Parasitology 15:346–364.

Le-Van-Hoa. 1965. Étude des nématodes du genre *Rictularia* Froelich 1802 chez les rongeurs du Sud-Vietnam. Bulletin de la Société de Pathologie Exotique 58:916–928.

Myers, B. J., and R. E. Kuntz. 1960. Nematode parasites from vertebrates taken on Lan Yu, Formosa. I. Nematodes from *Rattus rattus*. Canadian Journal of Zoology 38:857–858.

Ono, S. 1933. Studies on the life-history of Spiruridae in Manchuria. I. The morphologic studies on the encysted larvae found in 2 species of dung-beetle, dragon-fly, hedgehog, domestic fowl and duck, as well as their infestation experiments with rabbits and dogs. Journal of the Japanese Society of Veterinary Medicine 12:165–184. (In Japanese.)

Popova, T. I. 1955. Strongyloids of animals and man. *In* K. I. Skrjabin, ed. Osnovy Nematodologii. Vol. 5. Izdatel'stvo Akademii Nauk SSSR, Moscow. 224 pp. (In Russian.)

Schmidt, G. D., and R. E. Kuntz. 1967. Nematode parasites of Oceania. II. Redescription of *Rictularia whartoni* Tubangui, 1931, and notes on other species from Palawan, P. I. Journal of Parasitology 53:1281–1284.

Shmitova, G. Y. 1964. Study of the ontogenic development of *Ascarops strongylina*. Trudy Gel'mintologicheskoi Laboratorii 14:288–301.

Shoho, C., and M. Machida. 1979. Nematode parasites of wild boar from Iriomote Island, Japan. Bulletin of the National Science Museum, Series A (Zoology) 5:235–247.

Singh, M., and C. H. Cheong. 1971. On a collection of nematode parasites from Malayan rats. Southeast Asian Journal of Tropical Medicine and Public Health 2:516–522.

Tanaka, K., Y. Kurosawa, and T. Oishi. 1981. Genetic studies on the native pigs in Taiwan. II. Blood groups and electrophoretic variants of serum proteins in short-ear breed. Japanese Journal of Swine Science 18:197–183. (In Japanese.)

Tokuda, M. 1941. A revised monograph of the Japanese and Manchou-Korean Muridae. Biogeographica 4:1–155.

Tubangui, M. A. 1931. Worm parasites of the brown rat (*Mus norvegicus*) in the Philippine Islands, with special reference to those forms that may be transmitted to human beings. Philippine Journal of Science 46:537–591.

Webster, W. A., and G. Speckmann. 1977. The description of a gubernaculum in *Ascarops strongylina* (Rudolphi, 1819) (Spiruroidea) and a note on the recovery of this nematode from a bird. Canadian Journal of Zoology 55:310–313.

Yamaguti, S. 1935. Studies on the helminth fauna of Japan. Part 13. Mammalian nematodes. Japanese Journal of Zoology 6:433–457.

Yokogawa, S. 1920. A new nematode from the rat. Journal of Parasitology 7:29–33.

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